Based Upon: PCT/EP2004/000015

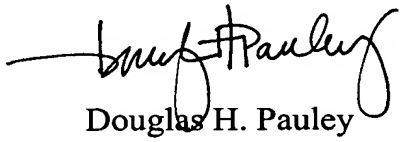
REMARKS

Applicant respectfully requests entry of the above Preliminary Amendment to place this U.S. Patent Application in better form for examination and prosecution before the U.S. Patent and Trademark Office.

The claims have been amended to eliminate multiple dependent claims and to more definitely and fully claim the subject matter of Applicant's invention. Applicant urges that the above Preliminary Amendment introduces no new matter into this U.S. Patent Application.

Applicant sincerely believes that this U.S. Patent Application is now in condition for examination and prosecution before the U.S. Patent and Trademark Office.

Respectfully submitted,



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Tool Guiding Device

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a tool guiding device with a base frame and guide rails, which are parallel in relation to each other, arranged thereon, on which at least one carriage is provided with a processing tool is displaceably linearly guided via a carriage connector by means of a drive mechanism.

Discussion of Related Art

Such a tool guiding device, which for example is used in punch presses for producing punched workpieces, requires a very exact guidance of, for example, a lower and an upper pressing tool, for which purpose an upper carriage, on which an upper die is received, and a lower carriage, on which a lower die is received, are guided on guide rails of the base frame, for example on at least two, mostly four guide rails extending parallel in respect to each other. The carriages are coupled via respective carriage connectors to an actuating drive mechanism, by means of which the carriages can be displaced into a predeterminable height position by means of a control device. For assuring an exact placement of the lower die and the upper die, the guide rails and the adjustment of the carriages by means of the carriage connectors and the actuating drive must be matched to each other very accurately in order to keep distortions and tool wear as low as possible.

SUMMARY OF THE INVENTION

The object of the invention is based on making available a tool guiding device of the type mentioned at the outset, by means of which an increase in precision and service life can be achieved, along with a reduced outlay.

This object is attained by means of the characteristics of claim 1. In accordance therewith it is provided that the carriage is coupled to the carriage connectors via

at least one compensating device having at least one angle compensation element and at least one lateral compensation element.

A stress-free guidance of the carriages extending exactly along the guide rails is achieved by means of the at least one angle compensation element and at least one lateral compensation element between the guide rails and the carriage connector, so that a tool can be conducted very accurately to the treatment location. A long service life of the tools is obtained by this. Moreover, an exact processing of workpieces is made possible, so that finishing work and setup times are also minimized.

Advantageous alternative embodiments of the tool guide device are obtained in that the angle compensation element is embodied as a ball element or ball section element, which is rigidly connected with the carriage connector and is seated, on its side facing away from the carriage connector, in an articulated manner in a ball socket of an intermediate piece, and,

a) that the intermediate piece has a further ball socket on its side facing away from the ball socket, in which a further ball element or ball section element, which is connected with the carriage, is seated in an articulated manner, or

b) that on its side facing away from the ball socket, the intermediate piece is seated by means of a roller, ball or sliding bearing with a plurality of rolling, ball or sliding bodies laterally transversely to the displacement direction of the carriage in the latter.

The guiding of the carriage is favored in that the carriage is maintained and guided on facing tracks on facing sides of the guide rails by revolving roller or ball units.

Further stabilization and accuracy of guidance is achieved in that on the respectively oppositely located sides of the guide rails respective pairs of guide tracks are arranged, which in cross section are oriented angled or parallel with each other, on each of which a revolving roller or ball unit rolls off, wherein the two pairs of guide tracks extend parallel with each other in the linear direction.

For increasing the wear resistance it has been advantageously provided that, in its two end areas located in the guiding direction, the carriage is provided with strippers, at least in the area of the guide tracks, and that for sealing the space between the guide rails and the carriages sealing elements are provided on the latter. It is also possible in a simple manner to provide for lubrication in the sealed space between the carriage and the guide rails. An additional deflection of dirt can be achieved by a pressure buildup in the space.

A very exact, stable alignment of the guide rails, and therefore of the carriage guidance, is achieved in that rail guides for fastening the guide rails have been cut into the base frame.

The exterior of the guide rails remains unaffected and can be easily kept free of dirt particles if it is provided that the guide rails are connected with the base frame from a direction of the side of the base frame.

An advantageous arrangement for processing workpieces consists in that the base frame has a table and that two guide rails are attached in a vertical orientation to a vertical section extending from below the table to above it, and that a gate is formed above the table top in the vertical section between the guide rails, so that access paths to a treatment location of the tool are provided from four horizontal directions. It is easily possible to

introduce pulverulent, liquid, pasty or solid materials into the treatment location through the gate by means of a suitable feed device via a feeding arm, for example.

In this case an advantageous embodiment consists in that an upper carriage is arranged above the table top, and a lower carriage below the table top.

A further advantageous embodiment for treating a workpiece consists in that a passage for an ejector is formed in the at least one angle compensation element and at least one lateral compensation element.

Moreover, it has been advantageously provided for an exact positioning of the tool that a measuring pickup of a measuring system is arranged between two guide rails in the area of the respective carriage for adjusting a carriage position.

The invention will be described in greater detail in what follows by means of exemplary embodiments, making reference to the drawings. Shown are in:

Fig. 1A a partially cut-open tool guiding device in a lateral view;

Fig. 1B the device in accordance with Fig. 1A in a front view;

Fig. 1C the device in accordance with Fig. 1A in a view from above;

Fig. 2A a guide rail with a carriage of the tool guiding device in a lateral view;

Fig. 2B the guide rail with the carriage in accordance with Fig. 2A in a view from above in the guidance direction;

Fig. 2C a cut-out portion of a different guide rail;

Fig. 3A a compensating device of the tool guiding device;

Fig. 3B a further exemplary embodiment of a compensating device; and

Fig. 4 shows a lateral sectional view of a cut-out portion of the tool guiding device in a table area.

DESCRIPTION OF PREFERRED EMBODIMENTS

One exemplary embodiment of a tool guiding device, such as is used in connection with a punching press, for example, is shown in Figs. 1A, 1B and 1C. A base frame 1 has a table 1.3 in its lower front area, and in its rear area a vertical section extending upward above the table, to which front side two parallel rail guides 1.1 for guiding an upper carriage 3 and a lower carriage 4 are attached. Here, the guide rails are arranged laterally of a gate 1.2 formed above the table top in the vertical section of the base frame 1 and are attached to rail guides 1.1, which are cut, for example machined, into the vertical section, so that an exactly aligned, rigid and stable connection with the base frame 1 results.

As Figs. 2A and 2B show, the guide rails 2 are fastened from the direction of the side of the base frame by connection means 2.1 provided on their back, in particular connecting bores and screws engaging the latter. The table is freely accessible from the front and the two sides so that, together with the gate 1.2, access paths 12 to the treatment location result on all sides, and feeding of material, for example pulverulent, liquid, pasty or solid matter, to the treatment location can occur unhampered from the rear, for example via a feed arm, as shown by way of example in Fig. 4.

The upper carriage 3 arranged above the table top, and the lower carriage 4 arranged below the table top are moved into the desired position by an actuating device (not represented) via respective carriage connectors 10 or 11 along the guide paths formed by the guide rails 2. For compensating a not exactly existing parallelism between the actuating

device (indicated by large arrows in Fig. 1A) and the orientation of the guide rails 2 (indicated by small arrows in Fig. 1A), respective compensating devices 9 with angle compensation elements 9.4 and lateral compensation elements 9.1, 9.5, 9.6 have been formed in the upper carriage 3 and the lower carriage 4 and can advantageously be embodied corresponding to the exemplary embodiments in accordance with Figs. 3A or 3B.

In accordance with Fig. 3A, a ball element 9.4 is arranged in the upper carriage 3, is rigidly connected with the carriage connector 10, and is seated, articulated in all directions, in an upper ball socket 9.11 of an intermediate piece 9.1, and is maintained by means of a spring element 9.2 for clamping free of play. On its side facing away from the ball socket 9.11, the intermediate piece 9.1 has a further ball socket 9.12, in which a ball section 9.5, rigidly connected with the housing of the upper carriage 3, is also seated in a manner in which it is articulated in all directions. By means of the articulated seating and the distance of the ball element 9.4 from the ball section 9.5, this structure results in an angular compensation between the actuating direction and the guide direction of the carriage 3, and also in a lateral compensation as well, i.e. in the present case in the horizontal direction.

In the exemplary embodiment in accordance with Fig. 3B, the underside of the intermediate piece 9.1 is seated or slidingly conducted on a rolling or ball bearing with individual rollers or balls, so that the angle compensation is achieved by means of the ball element 9.4 in the ball socket 9.11, and the lateral compensation via the roller or ball bearing, or the sliding guidance.

Guidance errors are compensated by means of the angle and transverse compensation in accordance with Figs. 3A and 3B, and distortions of the upper carriage 3, and correspondingly also of the lower carriage 4, in the guide rails are prevented and a highly accurate guidance without undesired transverse forces and bending moments is obtained. Furthermore, carriage guide devices 3.1, 4.1 attached to the upper carriage 3 and the lower carriage 4 contribute to exact guidance and low wear, and roll off by means of roller running units or rolling running units on facing guide tracks 2.3, 2.3' of the guide rails 3 in the course of adjusting the carriages 3, 4. In this case the guide tracks can be arranged as in Fig. 2B or Fig. 2C. With the embodiment in accordance with Fig. 2C, a pair of guide tracks 2.31, 2.32, which are arranged at an angle in relation to each other and on each of which a prestressed guide unit runs off, is provided on each side of the guide tracks 2. The pairs of guide tracks 2.31, 2.32 extend exactly parallel with each other in the linear direction. The space inside the carriage guide devices 3.1, 4.1 is sealed toward the outside by encircling sealing means and can advantageously be charged with pressure and lubricated with oil. On their end areas located in the running direction, the carriage guide devices 3.1 each have strippers 2.2 for preventing soiling and for maintaining exact guidance properties. It is furthermore possible to provide additional sealing lips and strippers toward the outside.

As Figs. 1A and 1B furthermore show, the upper carriage 3 and the lower carriage 4 have on their facing sides an upper die 14 or a lower die 13 for shaping a workpiece, for example the cutting plate of a chip-removal tool. Alternatively it is also possible to attach chucks for receiving other tools on the upper die 14 or the lower die 13.

As Fig. 4 shows, a bottom die 15 in the shape of the workpiece is arranged in the table area and can be received, for example, in a chuck 15.1 (see Fig. 1A). For filling, a filler plate arrangement 16 is provided, on which a filler shoe 16.1 for feeding in filler material is arranged. The filler plate can be height-adjusted to be flush with the upper edge of the bottom die by means of a filler plate adjustment device, so that a gap-free transition to the bottom die is created. Filling without losses takes place via the filler shoe 16.1. The height adjustment takes place via a guide device 16.5 without changing elements with a pressure or gas spring 16.2 or a cylinder drive mechanism. In one operating position, the height position is clamped by means of a spring and/or a wedge, and can be released pneumatically via an actuating means 16.4. Alternatively, it is possible to provide a manually operable clamping and release device. By means of a sensor arrangement 16.6, which does not need to be reset, it is possible to determine whether any and which press elements are present. Soiling can be removed by blowing off the press elements by means of a suction device 16.7 automatically after each pressing operation. To be able to produce a tool with an inner contour (for example a hole), a center pin is provided, which can be moved in the axial direction. An evaluating device can also be employed at this location. For a simple operation of the ejector 17, or the center pin, a passage 9.3 has been formed in the compensating device, which leads through the ball element 9.4, the intermediate piece 9.1 and the ball section 9.5.

Respective measuring systems 5, 6 have been arranged in the vicinity of the carriage guide devices 3.1, 4.1 for the exact positioning of the upper carriage and the lower

carriage, so that the measurement takes place close to the tools and measuring errors on the basis of an increased measurement distance or amplification via levers are made impossible.

The base frame 1 can be exactly adjusted between the external machine shafts (carriage connectors) by means of leveling devices 8 represented in Figs. 1A and 1B.